

Greenhouse Gas Emissions as Impacted by Growth Media for Three Common Flowering Plants

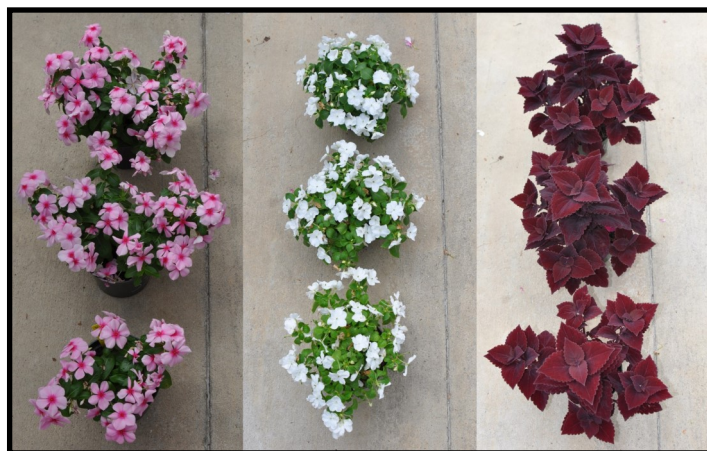


Figure 1. Three common annual ornamental plants evaluated in this study: vinca, impatiens, and coleus (left to right). This picture was taken at the end of the study and illustrates that plant marketability was not impacted by growth media.

Dynamically Speaking

As the weather warms and the Spring planting season starts, the National Soil Dynamics Laboratory (NSDL) is busy establishing this year's experiments across the State of Alabama. In this letter, I would like to announce that the NSDL received funding to build a new facility on the Auburn University campus for our research. The U.S. Congress has appropriated 43.3 million dollars to be used to build this new state-of-the-art facility. We are just now starting the planning process, so it will be a several years before the new facility is completed. In the mean time, we will continue our ongoing efforts in agriculture research. I hope you enjoy reading about some of the research efforts we have included in this issue of *National Soil Dynamics Highlights*.



H. Allen Torbert
Research Leader

The global climate may be altered by increases in greenhouse gases (GHG) such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) associated with agriculture. Agriculture is second to energy production in atmospheric emissions of these three major greenhouse gases; however, little work has focused on specialty crop industries such as horticulture. Greenhouse, nursery, and floriculture systems contribute to the economics of producing ornamental trees, shrubs, and perennial and annual flowering plants that populate suburban and urban landscapes.

In collaboration with Auburn University's Department of Horticulture, we conducted a study to evaluate GHG emissions as impacted by nursery media for three popular annual plants (Fig. 1) that are commonly produced in greenhouses (vinca, *Catharanthus roseus* L. 'Cooler Grape'; impatiens, *Impatiens walleriana* Hook. f. 'Super Elfin XP White'; and coleus, *Solenostemon scutellarioides* Thonn. 'Redhead'). Growth media evaluated were: 1-) 80:20 fine professional sphagnum peatmoss:coarse horticultural perlite (P:P) blend (industry standard); 2-) 80:20 peatmoss:Wholetree (P:WT) blend; and 3-) 60:40 P:WT blend]. Figure 2 shows one block on the greenhouse bench immediately following transplanting into the different media mixtures that were evaluated in the study; this picture also includes the control containers with no plants.

Overall, marketability of all three annual plants was not affected by the different growth media evaluated in this study (Fig. 2). Results show that CH₄ losses were minimal across all three media types for these common annual plants. No differences in N₂O loss were seen among the three media. However, total CO₂ loss differed by plant size and media (Fig. 3). Carbon dioxide loss was greatest for the larger Coleus plants. Generally, the media with the higher amount of wood fiber (60:40 P:WT) had higher CO₂ loss, while replacing the perlite (80:20 P:P) with

...Gas Emissions cont.

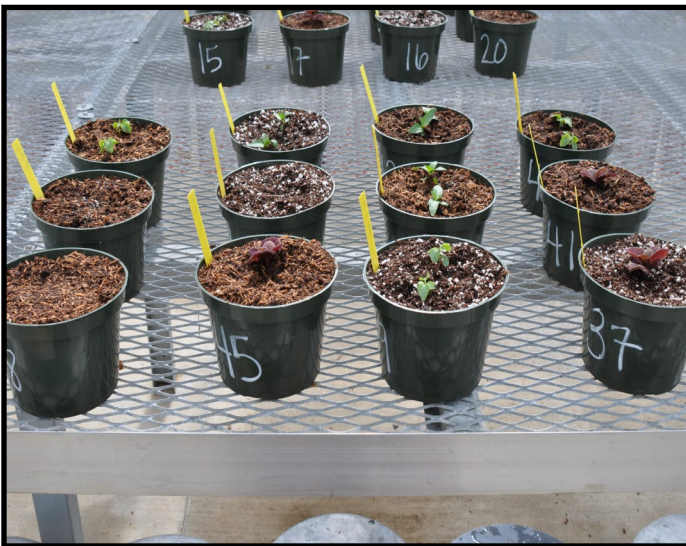


Figure 2. A single block on the greenhouse bench showing the different media mixtures that were evaluated in the study, including controls with no plant. This picture was taken at the beginning of the study, immediately following transplanting.

wood fiber (80:20 P:WT) had no effect on CO₂ loss. For container producers aiming to replace perlite with a locally available, high wood fiber substrate, these results are promising. However, further research is needed to determine if these results are typical of other horticultural annual plants as well as perennials and woody ornamental plants.



Figure 3. Method used for gas (CH₄, N₂O and CO₂) sampling showing a plant container in the PVC chamber (left) and a technician extracting a gas sample using a syringe following placement of the sampling head on the PVC chamber (right).

Upcoming Events

Dates	Meeting	Location
June 19-21	Soil and Water Conservation Society (SWCS)-AL Chapter Annual Mtg	Foley, AL
July 9-11	Americ. Peanut Res. Edu. Soci. Annual Meeting	Auburn, AL
July 16-17	Southern Cover Crop Conference	Auburn, AL
July 18-20	Southern Peanut Growers Conf.	PC Beach, FL
July 29 -Aug 1	SWCS 73 rd International Annual Conference	Albuquerque, NM
Oct 15-18	Sunbelt Agricultural Expo	Moultrie, GA

High Residue Cereal Rye Provides 8 Days of Weed Suppression for Cotton

Due to an increase in tillage and unprecedented herbicide resistant and troublesome weed yield loss, there is an urgent need for integrated weed management strategies. This need was highlighted in a Weed Science journal special issue "Herbicide Resistant Weeds" containing a brief best management practice section entitled "Cover Crops and Synthetic Mulches" describing the necessity to understand diverse best management practices, including "cultural management techniques that suppress weeds".

One potential cultural management technique is to increase a crop's competitiveness against weed interference. To evaluate this effect, weed scientist measure the critical period for weed control. This is the time interval in crop growth when a weed-free state must be maintained to prevent substantial ($\geq 5\%$) yield loss. The critical period for weed control has two separately measured weed-crop competition components: 1) the critical timing for weed removal (i.e. the maximum time duration the crop can tolerate early-season weed competition before incurring increasingly substantial yield loss) and 2) the critical weed-free period (i.e. the minimum time duration from time of planting onward when a crop needs to be kept weed free to prevent substantial yield losses above a predetermined level).

In a study to evaluate cotton critical period for weed control, three systems were evaluated: conventional tillage without a cover crop, conservation tillage following

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... Cereal Rye cont.



Figure 4. Seedling cotton growing in high residue cereal rye cover crop.

winter fallow, or conservation tillage following a cereal rye cover crop managed for maximum biomass. Each system was then exposed to various durations of naturally occurring weed interference and weed free periods. These periods consisted of 10 durations in one-week increments up to 70 days after planting. Season long weed free, as well as season long weed interference, were also included.

Results revealed that a high-biomass cereal rye cover crop suppressed early season weed biomass and extended the critical weed-free period, thus delaying the start of the critical period for weed control (Fig. 3). The presence of a high residue rye cover crop delayed the critical timing for weed removal approximately 8 days compared to fallow treatments providing substantial weed suppression. Results also indicated winter fallow should be avoided to minimize cotton yield loss in conservation systems. The take home message is that integrating weed suppressive high biomass cover crops in cotton could decrease troublesome weed interference and subsequently decrease reliance on herbicides or tillage.

Traction Performance of Tractor Tires

The weight supported by the tire of a tractor or other agricultural vehicle and the tire air pressure affect traction performance and soil compaction. Several research projects with tractor drive tires have been conducted in the soil bins at the National Soil Dynamics Laboratory (NSDL). In one project, a 480/80R38 (same as 18.4R38) radial-ply tractor drive tire was run at 10% slip on a Norfolk sandy loam soil (72% sand, 17% silt, and 11% clay) and on a Decatur clay loam soil (27% sand, 43% silt, and 30% clay).

Each soil had been rotary-tilled, so the initial condition of each soil was a soft soil condition. The Traction Research Vehicle (Fig. 5) controlled the vertical load on the tire, the air pressure, and tire slip. The tire in this project was run at two correct combinations of load (weight supported by the tire) and air pressure, as specified in the load and inflation pressure table for this tire. Also, the tire was run using one combination in which the tire was overinflated (Table 1).

Recent Publications

Price, A.J., Williams, J., Duzy, L.M., Mcelroy, S., Guertal, B., Li, S. 2018. Effects of integrated polyethylene and cover crop mulch, conservation tillage, and herbicide application on weed control, yield, and economic returns in watermelon. *Weed Technology*. 32:623-632. <https://doi.org/10.1017/wet.2018.45>.

Kornecki, T.S., Prior, S.A., Runion, G.B. 2018. Innovative method for cover crop termination using engine exhaust heat. *European Agrophysical Journal*. 5(4):145-156.

Duzy, L.M., Kornecki, T.S. 2018. Effects of cover crop termination and cotton planting methods on cotton production in conservation systems. *Renewable Agriculture and Food Systems*. p. 1-9. <https://doi.org/10.1017/S1742170517000631>.

Price, A.J., Korres, N., Norsworthy, J., Li, S. 2018. Influence of a cereal rye cover crop and conservation tillage on the critical period for weed control in cotton. *Weed Technology*. 32:683-690. <https://doi.org/10.1017/wet.2018.73>.

Constantino, V., Barbosa, J.Z., Motta, A.C., Dolinski, M.A., Prior, S.A., Zanette, F. 2018. Initial growth of *Araucaria angustifolia* (Bertol.) Kuntze in response to fertilization with nitrogen, phosphorus and potassium. *Floresta*. 49(1):99-108. <https://doi.org/10.5380/rev.v49i1.57467>.

Tewolde, H., Shankle, M.W., Way, T.R., Pote, D.H., Sistani, K.R. 2018. Poultry litter band placement in no-till cotton affects soil nutrient accumulation and conservation. *Soil Science Society of America Journal*. 82:1459-1468. doi:10.2136/sssaj2018.04.0131.

Balkcom, K.S., Duzy, L.M., Price, A.J., Kornecki, T.S. 2019. Oat, rye, and ryegrass response to nitrogen fertilizer. *Crop, Forage Turfgrass Management*, vol. 5, 1-6 [Online]. Available at <http://dx.doi.org/10.2134/cftm2018.09.0073>

All of our publications are available on our web site:
<http://www.ars.usda.gov/sea/nsdl>

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Happenings

November 4-7, 2018, ARS Scientists, Dr. Dexter Watts, Dr. Kip Balkcom and Dr. Allen Torbert attended the 2018 American Society of Agronomy and Crop Science Society of America Meeting in Baltimore, MD. Dr. Watts presented a paper titled “Influence of FGD Gypsum on the Physical Properties of Soils”, Dr. Balkcom presented a paper titled “Single and Multi-Species Cover Crop Performance”, and Dr. Torbert presented a paper titled “Impact of FGD Gypsum and Poultry Litter Application on Transfer of Potentially Toxic Elements to Plants, Soil, and Runoff”.

November 27-29, 2018, Dr. Allen Torbert, Soil Scientist, attended the Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP) Symposium and made a presentation titled “Beneficial Use of Classified Paper Waste for Training Land Rehabilitation”.

January 23-26, 2019, ARS Agricultural Engineers, Dr. Ted S. Kornecki and Mr. Corey Kichler, of the National Soil Dynamics Laboratory (NSDL) in Auburn, AL attended the 2019 Southern Sustainable Agriculture Working Group (SAWG) Conference in Little Rock, Arkansas. Dr. Kornecki presented an innovative “Modular Apparatus for Cutting Cover Crop Residue in a No-Till Planting System” and Mr. Kichler demonstrated their patented no-till transplanter for an Oggun tractor and a prototype of the modular powered cover crop residue cutter designed to distribute conservation tillage materials to attendees.

February 25, 2019, ARS Plant Physiologist, Dr. Andrew Price, National Soil Dynamics Laboratory, Auburn, AL made a presentation titled “Weed Biology and Control Following Winter Cover Crops” at the South Carolina Chapter of the Soil and Water Conservation Society annual symposium held in Columbia, South Carolina.

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... Tractor Tires cont.



Figure 5. Traction Research Vehicle running on a soil bin at the NSDL. Direction of forward travel is from right to left.

Table 1 shows the traction forces developed by the tire. Tractive efficiency is a measure of the tire efficiency (“Efficiency” in Table 1), and it is the ratio of drawbar power to axle power. For both soils, the tractive efficiency was greatest for the low load (2970 lb) with its correct air pressure (6 psi), was intermediate for the high load (5690 lb) with its correct air pressure (18 psi), and was least for the overinflated condition (2970 lb and 18 psi). These results demonstrate the traction performance advantage of using the correct air pressure for the load supported by the tire, and the reduced tractive efficiency when a tire is overinflated. Results from this project and similar projects conducted at the NSDL also show reductions in soil compaction when correct combinations of tire load and air pressure are used, compared to overinflated tires.

Table 1. Combinations of tire load and air pressure used and traction performance results. Tire was correctly inflated for the first two rows of data here and tire was overinflated (load was meant for 6 psi, but 18 psi was used) for the last row.

Load	Air pressure	Norfolk Sandy Loam		Decatur Clay Loam	
		Traction	Efficiency	Traction	Efficiency
—lb—	—psi—	—lb—		—lb—	
2970	6	1210	0.67	1280	0.70
5690	18	1870	0.62	2000	0.67
2970	18	880	0.58	970	0.64

Send updated contact information, questions, comments, and/or suggestions to: NSDL-Highlights@ars.usda.gov

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